

Evaluating Changing Sediment Contamination Conditions, Santa Monica Bay

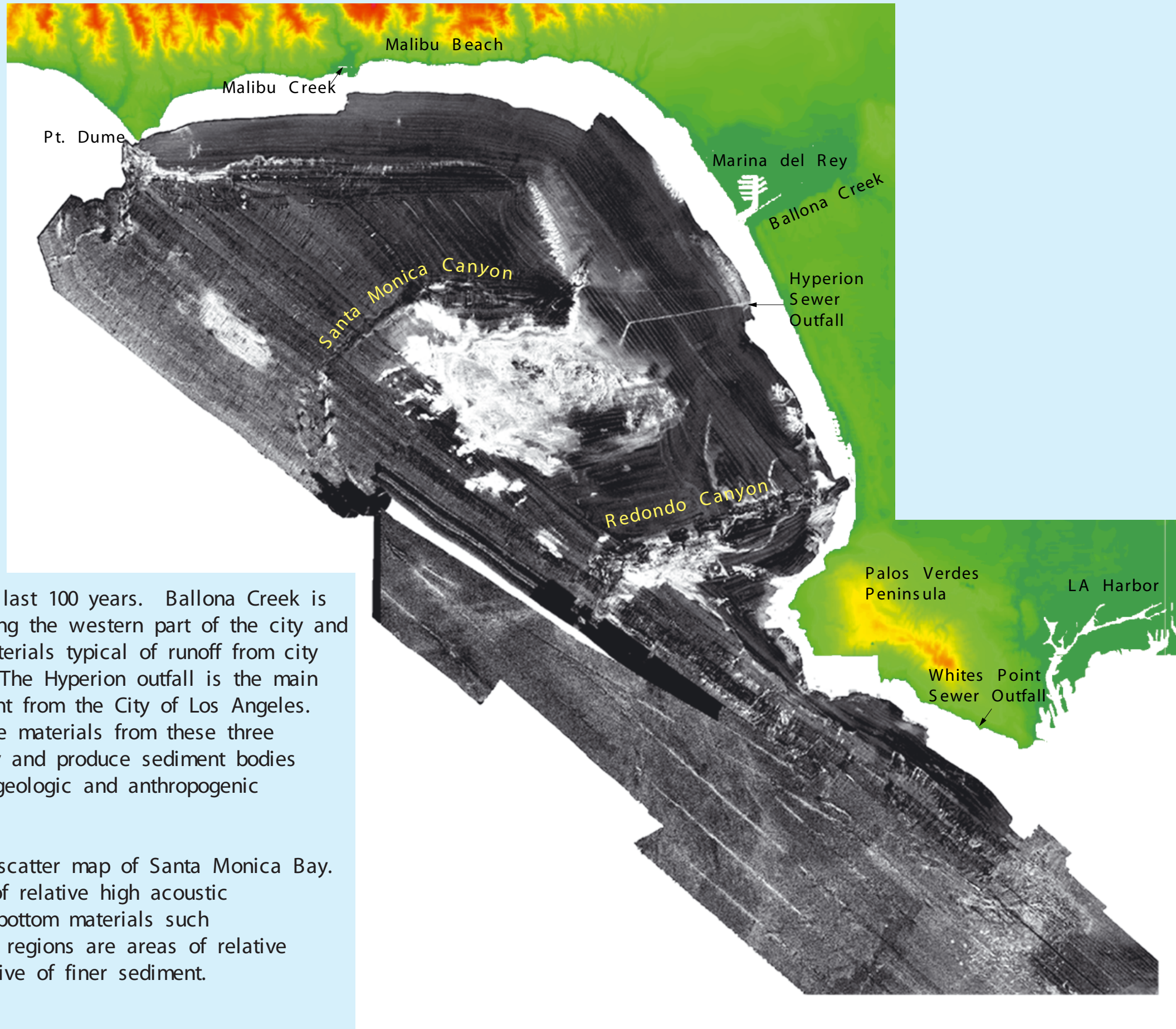
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The Southern California Coastal Water Research Project, the City of Los Angeles, and the United States Geological Survey are collaborating to investigate sediment pollution on the floor of Santa Monica Bay, offshore of the greater Los Angeles metropolitan area.

The Setting:

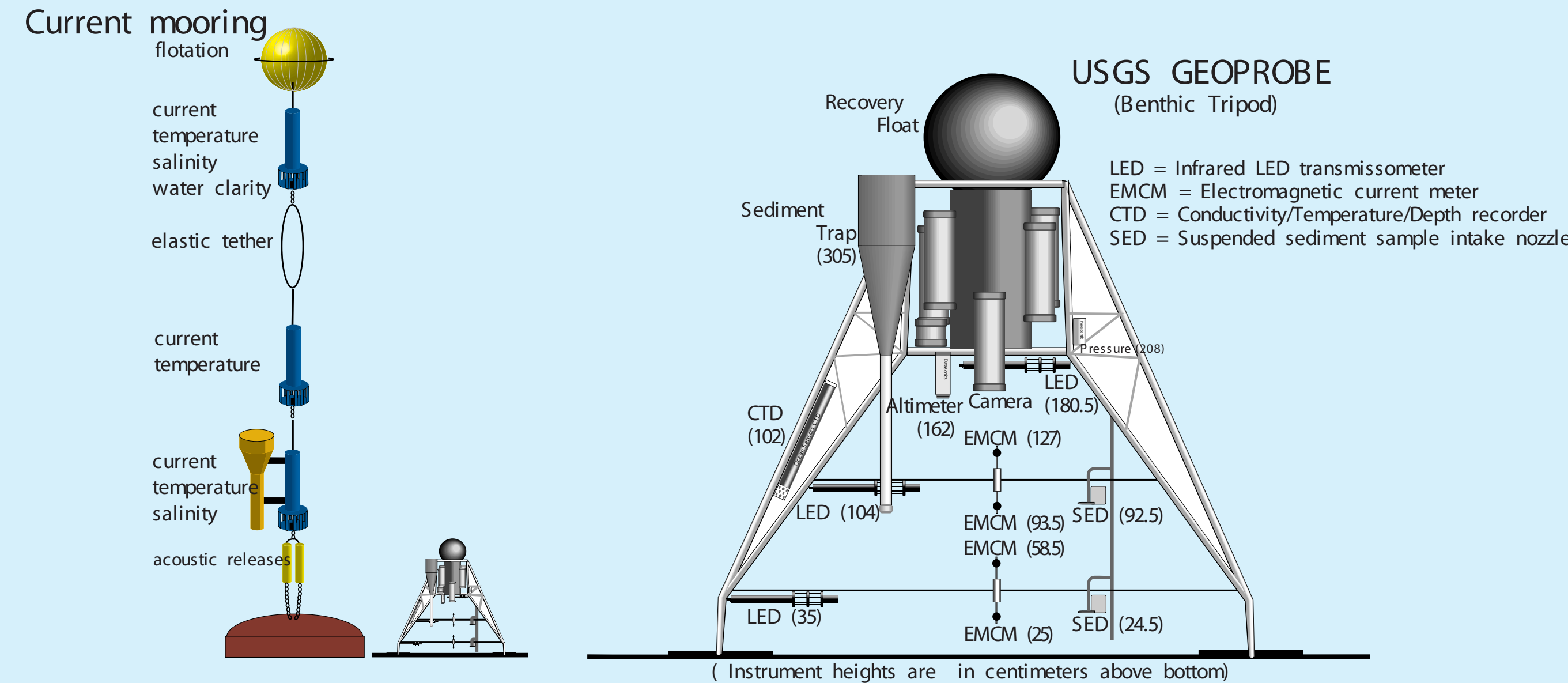
Santa Monica Bay lies to the west of the most developed part of the Los Angeles metropolitan area. The Bay receives input from three major sources: Malibu Creek, Ballona Creek, and the Hyperion Sewage outfall. Malibu Creek drains a part of the largely undeveloped Santa Monica Mountains and has been relatively unaffected by the tremendous development of the Los Angeles area over the last 100 years. Ballona Creek is an urban drainage channel, draining the western part of the city and carrying with it anthropogenic materials typical of runoff from city streets, residences and industry. The Hyperion outfall is the main discharge point for sewage effluent from the City of Los Angeles. Sediment transport processes move materials from these three sources around Santa Monica Bay and produce sediment bodies that are a combination of native geologic and anthropogenic materials.

To the right is an acoustic backscatter map of Santa Monica Bay. Light shaded regions are areas of relative high acoustic backscatter indicative of harder bottom materials such as rock and sand. Dark shaded regions are areas of relative low acoustic backscatter, indicative of finer sediment.



Current Monitoring:

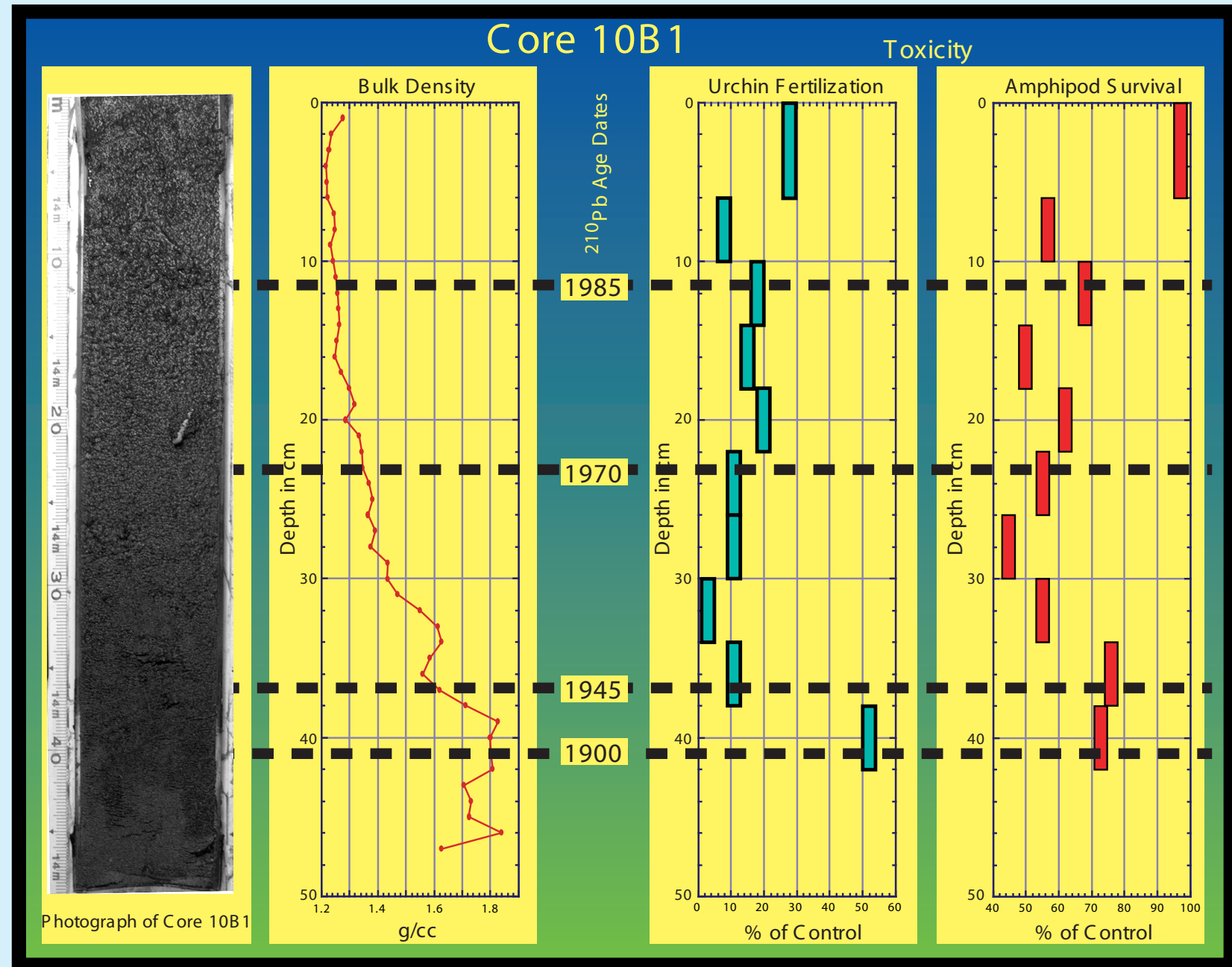
Predicting the fate of contaminated sediment grains requires an understanding of regional current patterns as well as the characteristics of water flow within a few meters of the seafloor. Long-term measurements of currents, wind stress, and the associated wave climate are needed to design predictive sediment transport and dispersal models. A current mooring was in place during the 1997-1998 El Nino winter off Marina del Rey to address these issues. Additional current moorings and benthic tripod were installed in December 1998 and will remain in place through the winter. Current moorings measure conditions such as currents, temperature, salinity and water quality throughout the water column. The benthic tripod measures similar conditions near the seafloor.



ABSTRACT

Santa Monica Bay, offshore of the greater Los Angeles metropolitan area, receives surface runoff, sewage, and industrial drainage. Recent surveys have shown that more than 95% of the area in the Bay has contaminants at concentrations exceeding the Effects Range Low (ER-L) threshold, a level at which biological effects begin to occur. We conducted a study of the sediment on the floor of Santa Monica Bay to determine the severity of present contamination conditions and how levels of contamination have changed over the period during which Los Angeles was industrialized (approximately 1900 to the present). We obtained a set of box core samples at station locations defined using a stratified random design. Sediment samples were dated using short-half life radioisotopes (Pb-210) to define five time lines extending back over the last 100 years. Sediment from each of these time lines was tested for chlorinated hydrocarbons, metals and toxicity, as well as texture and physical properties. Analysis of these data show that, although surface sediment in the bay is still contaminated, contamination levels in the past were even greater. Overall conditions of sediment contamination in the Bay are improving. In addition, sediment data are combined with monitoring of currents and bottom boundary layer conditions to better understand patterns and rates of sediment and contaminant transport in the Bay. Our goal is to determine the geographic and stratigraphic distribution of contaminated marine sediment and to develop a predictive model for improving environmental management of this urban, coastal ocean. Ongoing studies of the mineralogy and organic chemistry of sediment samples are designed to assess the provenance and relative importance of inputs from several coastal streams, bluffs, and anthropogenic sources.

Core Profiles:



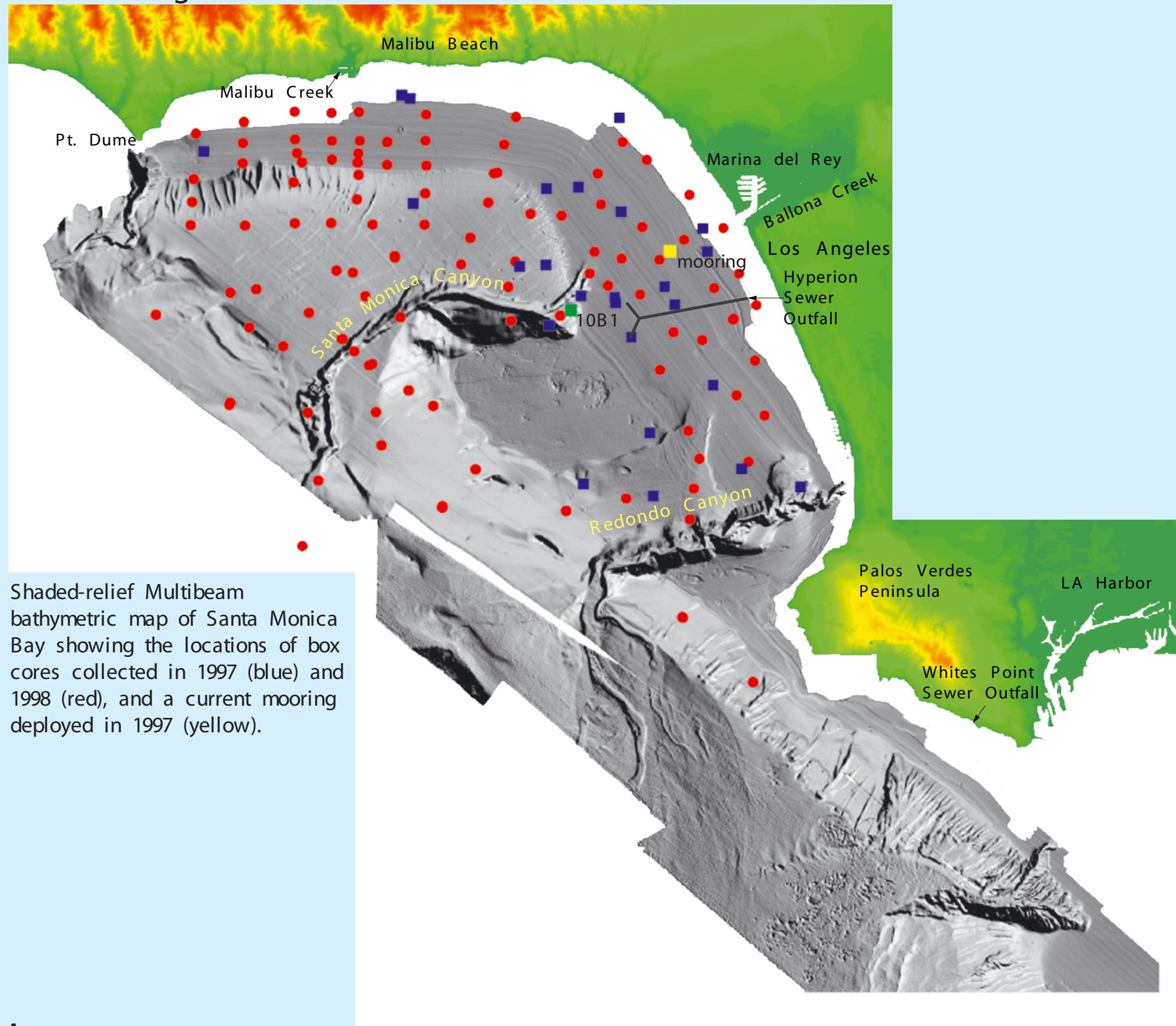
Sediment samples are dated, using short-half-life radioisotopes (Pb-210), along five time lines- 1900, prior to industrial development; 1945, a time of increasing development in the Los Angeles Basin; 1970, when sediment contamination was thought to be severe; 1985, following efforts to reduce contaminants in the bay; and 1997/1998 when the cores were taken.

Samples are tested for physical and textural properties (e.g. bulk density, velocity, magnetic susceptibility, and acoustic impedance) as well as for chlorinated hydrocarbons, metals and toxicity. The results are referenced to the lead-210 dating information.

Toxicity measurements are a standardized way to evaluate the impact of contaminated sediment on marine organisms. Two toxicity tests were used to evaluate the 26 box cores collected in 1997. An amphipod survival test was used to measure the toxicity of the sediment, and a sea urchin fertilization test was used to measure the toxicity of substances released from the sediment. To the left is a representation of both physical and toxicity tests from core 10B1 (green square on the above map) located near the historical discharge of sewage sludge (1957-1987) from the City of Los Angeles Hyperion Treatment Plant.

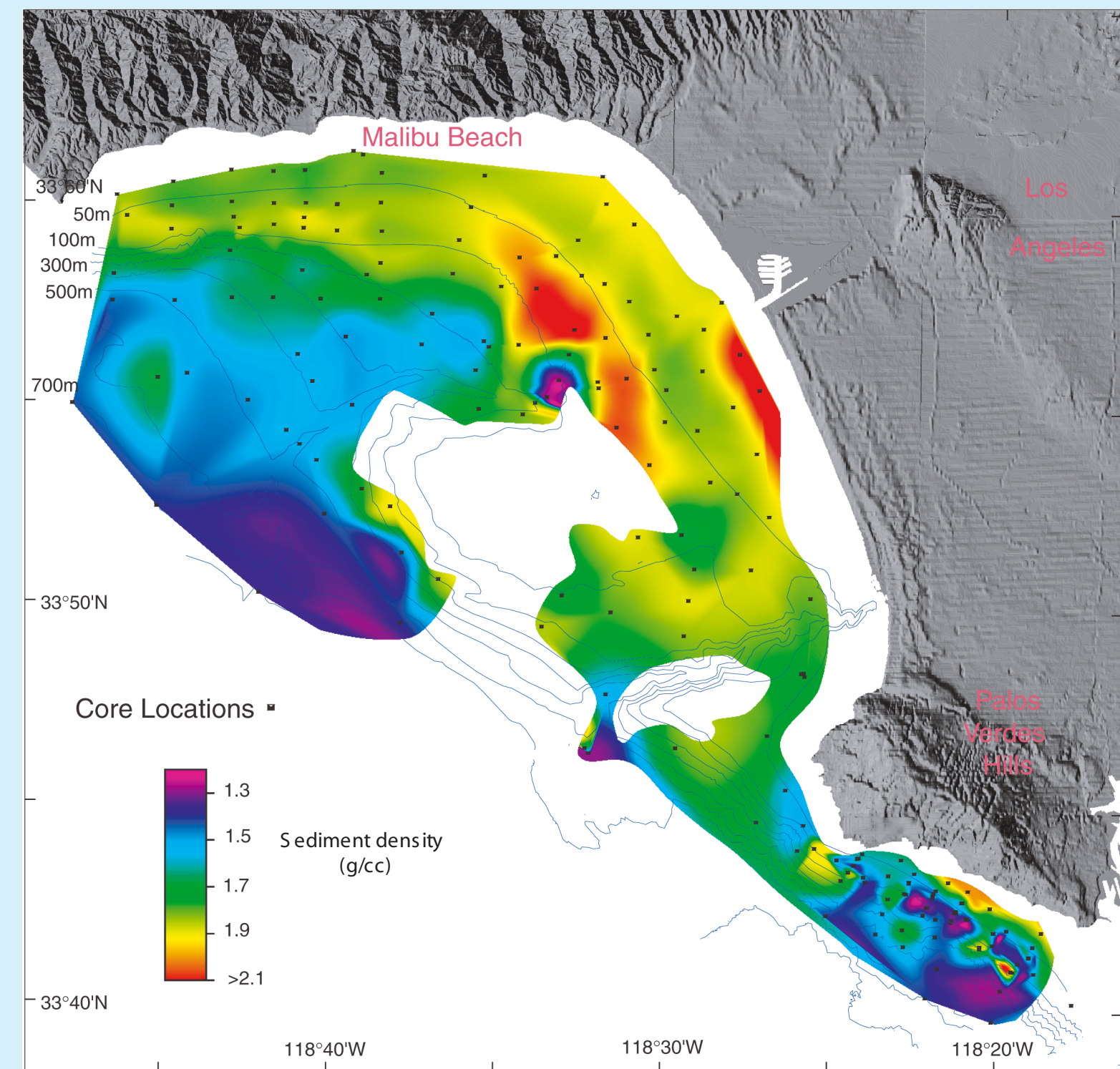
Both the amphipod survival and sea urchin fertilization tests detected toxicity in the core sections. The lowest levels occurred prior to 1950, before the initiation of wastewater disposal through Hyperion's outfall in 60 m of water, and after 1985, when steps were taken to reduce contamination levels. The results show that toxicity has been decreasing over the last two decades, suggesting improved contamination conditions.

Sediment Monitoring:



Shaded-relief Multibeam bathymetric map of Santa Monica Bay showing the locations of box cores collected in 1997 (blue) and 1998 (red), and a current mooring deployed in 1997 (yellow).

GIS Maps:



Data from sediment samples (locations shown as dots) are presented as GIS layers that can be used in further analysis. An initial layer shows the variation of surficial density over Santa Monica Bay. The density data were obtained through gamma-ray logging of whole cores and represent a depth of 15 cm in the sediment column. Greater densities typically correspond to coarser sediment.